MEaSUREs Reflectivity data for Earth's Surface Clouds and Aerosols since 1979 from Multiple Satellites (TOMS, SBUV, SBUV-2, OMI, and SeaWiFS, and in the future, NPP and NPOESS)

An overview of the MEaSUREs projects can be found at NASA MEaSUREs.

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The 31-year Earth Lambert Equivalent Reflectivity LER(t) = R(t) time series is obtained by producing a continuous ultraviolet 340 nm reflectivity data record for the surface of the Earth and its atmosphere. The record consists of combined intercalibrated multiple satellite data records since 1979. The surface reflectivities R obtained for cloud-free clear-sky ultraviolet (UV) wavelengths 340 nm are low (R ~ 0.04 to 0.05) over most surfaces (except ice and snow), and are almost independent of the seasonal changes in vegetation on land and in the oceans. This makes it ideal for examining changes in radiation reflected back to space from changes in cloud (0 > R < 1) and aerosol amounts (R < 0.15). Because fo the near constancy of the surface reflectivity in the UV, the long-term R(340 nm) data record can be used to estimate trends in cloud plus aerosol amount that might be associated with changing climate and interannual variability.

The ultraviolet directional albedo of the Earth's surface and atmosphere (clouds, aerosols, and Rayleigh scattering) has been accurately measured since the launch of Nimbus-7/TOMS and Nimbus-7/SBUV in October 1978. The measured directional albedo (the ratio of measured Earth radiance to measured solar irradiance) is converted to a quantity known as Lambert Equivalent Reflectivity. Since the first TOMS-SBUV (1979 to 1992), another series of satellite instruments (SBUV-2, OMI, and SeaWiFS) have been used to extend the reflectivity data record to produce a continuous climate quality Earth System Data Record (ESDR). The reflectivity data record will be extended during the life of this proposal to produce a 35-year (1979 to 2013) continuous ESDR, which can be further extended using the developed software from the proposed work and data from the ongoing GOME-2 satellite series, NPP (proposed launch in 2011), and followed by the NPOESS series.

Data http://avdc.gsfc.nasa.gov/index.php?site=1070363090

Click on V1

Product	Level/Type	Description	Source	Access
MEaSUREs Reflectivity	V1	N7/TOMS, SBUV, SBUV-2, OMI reflectivity at 331nm; SeaWifs at 412nm (contact Jay.R.Herman@nasa.gov, PI)	NASA/GSFC	public

There are 5 directories containing different versions of the reflectivity data.

1) **Zonal Average R(t) from the satellites at the time of measurement**

2) **Zonal Average R(t) from the satellites corrected back to local noon (see publication, Labow et al.)**

3) **Latitude by longitude (2 x 5 degrees) 10-day average gridded time series from the satellites at the time of measurement**

4) **Latitude by longitude (2 x 5 degrees) 10-day average gridded time series from the satellites corrected back to local noon (see publication, Labow et al.)**

5) Publications associated with the Reflectivity time series

The data were derived from newly re-calibrated production files for SBUV, SBUV-2, and OMI, Each satellite's data were calibrated using ice radiances and the pre-launch calibration. **No smoothing or magnitude adjustment has been made to make the files agree at the overlap points.** Two data sets are available. The first is obtained by forming zonal averages in 5 degree latitude bands from 65S to 65N. The second is a 10-day average latitude by longitude (2 degrees by 5 degrees) gridded data set. The 10-day average 2x5 degree resolution is necessary because of the nadir viewing SBUV-2 instruments, which obtain global coverage every 10 days.

Three available satellite instruments were not used in producing the UV reflectivity ESDR. Nimbus-7/TOMS had an uncertain calibration during its early years of operation. The Meteor-3 TOMS had a drifting orbit that passed through the day night terminator every 105 days. Earth-Probe TOMS (1997 - 2006) had a degrading calibration after 1999 that affected the single channel reflectivity determination. All of the TOMS instruments produced adequate values of ozone amount derived from a ratio of measured radiances.

A series of papers were published that describe the techniques used to derive the Lambert Equivalent Reflectivity (LER), its application to estimation of trends in LER, and the estimation of diurnal variability of the LER.

Herman, J. R., D. Larko, and J. Ziemke, 2001: Changes in the Earth's Global UV Reflectivity from Clouds and Aerosols. *J. Geophys. Res.*, **106**, 5353-5368.

Herman, J. R., E. Celarier, and D. Larko, UV 380 nm Reflectivity of the Earth's Surface, Clouds, and Aerosols. *J. Geophys. Res.,* **106**, 5335-5351, 2001.

Herman, J.R**.,** G. Labow, N.C. Hsu, D. Larko, Changes in Cloud Cover (1998-2006) Derived From Reflectivity Time Series Using SeaWiFS, N7-TOMS, EP-TOMS, SBUV-2, and OMI Radiance Data, J. Geophys. Res., 114, D01201, doi:10.1029/2007JD009508, 2009.

Labow, Gordon J., Jay R. Herman, Liang-Kang Huang, Steven A. Lloyd, Matthew T. DeLand, Wenhan Qin, Jianping Mao, David E. Larko, Diurnal Variation of 340 nm Lambertian Equivalent Reflectivity due to Clouds and Aerosols over Land and Oceans*, J. Geophy. Res.* , accepted, 2011.